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THE PROGRESS OF SOVIET AVIATION MEDICINE

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Russian scientists showed great interest in the effects of flight on the human organism as early as the past century. Thus, in 1804, the Russian Academician Ya. D. Zakharov, the first man to carry out a balloon flight for scientific purposes, included in his program of research a number of physiological questions relating to investigation of vision, observation of the pulse, breathing, and physical well-being. One of his investigations was entitled "Experiment on the Intensity of Sound Produced by the Ringing of a Bell."

Scientific literature of the second half of the 19th century contains quite a few interesting statements laying the ground for the further development of aviation medicine.

The talented Russian scientist M. A. Rykachev, who carried out a number of flights for scientific purposes, gave an excellent description of the nature of the activities of the aviator and of the personal qualities required of him. Simultaneously, the great Russian scientist D. I. Mendeleyev dealt with the problems of flight and the effects of flight on the human organism. In 1875, he definitely showed the necessity of sealed cabins for flights in the higher strata of the atmosphere. He worked out the first design of an aerostat with a sealed cabin (stratostat), which was built 50 years later.

Mendeleyev also pointed out the necessity of comfort in the machine of the future. Under the influence of Mendeleyev's idea, the airplane Ilya Muromets was the first one to be equipped with elementary sanitary facilities, totally lacking in the foreign airplanes of that time.

In 1891, the physician V. I. Grebenshchikov published "Medical Advice to Aviators," a compilation of the experience available up to that time in first-aid instructions for aviation accidents that might occur in unsuccessful crash landings.

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S. P. Munt, a medical officer, carried out the first physiological investigations during a series of flights, in 1897 - 1898, in a balloon especially equipped for these investigations. The balloon reached altitudes up to 6,000-7,000 meters. Munt investigated before, during, and after the flight, the capacity of the lungs, the strength of breathing and exhaling, the strength, rhythm, and quality of the heart beat, muscle strength, tactile and pain sensitivity, and carried out a number of other observations. One of his contemporaries wrote: "It is a special pleasure to note again that all these investigations of such wide scope and fundamental importance were first carried out here in Russia, while nothing like it has yet been done abroad."

In 1862, A. Katolinskiy carried out a number of experiments on the effect of compressed air on the human organism in a pneumatic chamber. Later, many Russian physicians worked on this problem (Smirnov, 1869, and Bochechkarov, 1879; Zhirimundskiy and Sukhorskiy in 1885; etc). All this work resulted in great contributions to aviation medicine and must be borne in mind in connection with the problem of oxygen supply under pressure.

The death of French balloonists during a high-altitude flight in 1875 attracted the attention of I. M. Sechenov, who was working on an investigation of the gases of the blood. "In 1879," he wrote in his Avtobiograficheskiye Ocherki (Autobiographical Sketches), "I was speculating about the reasons why the crew of the Zenith suffocated, in other words, I estimated to what extent the intake of oxygen had been insufficient for breathing." On 21 December 1879, Sechenov reported on the topic "Data on the Question of Penetration of CO_2 and O_2 Into the Blood Under Normal Breathing Conditions and During Downward Fluctuations of Air Pressure." This was the first scientific work on the nature of the physiological processes in the human body at lowered air pressure at certain altitudes. A little later, Sechenov published an article, "Breathing of Rarefied Air."

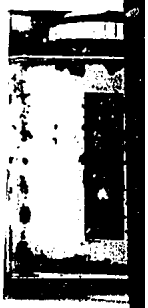
Sechenov's investigations provided a scientific basis for the physiological mechanism of altitude sickness and laid the groundwork for all subsequent work on oxygen starvation. Thus, there is all justification for calling Sechenov the father of Russian aviation physiology.

V. V. Pashutin, Sechenov's pupil, continued his work on the problem of the respiratory function of blood and, besides, carried out a number of experiments on the effect of centrifugal force and of the hydrostatic factor on blood circulation. In 1897 - 1898, he showed the role of the purely physiological regulation under the influence of the hydrostatic factor. Pashutin based this work on I. P. Pavlov's experiments on the physiology of blood circulation, in particular on his reports "On the Centripetal Accelerators of the Heart" and "On the Adjustment Mechanism of the Blood Vessels," published by Pavlov as early as 1874 - 1877.

I. M. Al'bitskiy, continuing the work of Sechenov and Pushutin, in 1844 defended a dissertation on the topic of the effect of oxygen starvation on nitrogen exchange. He first gave a criticism of the methods of Claude Bernard and Paul Ber [Baer?] and proposed his solution of ventilating a closed space with a gas mixture containing the required percentage of oxygen. Al'bitskiy was the first to undertake a study of the effect of prolonged oxygen deficiency.

During the middle of the past century, Russian designers, overcoming the conservatism of Tsarist officials, worked on the idea of flight in a heavier-than-air machine. This idea was realized for the first time in the world by the famous Russian inventor and scientist A. F. Mozhayskiy.

On 1 August (20 July) 1882, I. N. Golubev, a Russian, made a flight in an airplane of Mozhayskiy's design.



The progress of aviation technology attracted more and more attention. In 1908, physicians began to participate in the work of the All-Russian Aero Club, founded in 1908, and insisted on introducing mandatory physical checkups of aviators. The Council of the Aero Club decreed that "It is considered indispensable that active members of the Aero Club be permitted to carry out flights only under the condition that they undergo a medical examination." From that time on, the Army Medical Academy began to carry out aviation-medical examinations. No such measures were in effect at the time in any foreign country.

At this time, V. V. Abramov carried out experimental psychological investigations on aviators at the clinic of the great Russian psychiatrist V. M. Bekhterev. These were the first investigations of this kind in Russia, and took place quite some time ahead of such undertakings abroad. Bekhterev himself was interested in the questions of aeromedical examinations. Together with Prof V. V. Belousov, he carried out flights to study the activity during flight.

In the middle of 1912, the forming of military aviation units began in Russia. A little earlier, in October 1911, a commission of physicians had been formed at the St Petersburg Military Hospital, under the chairmanship of the chief of the hospital, Dr V. S. Sergeyev, "for the examination of the state of health of officers to establish their fitness for aviation service."

Docent V. I. Voyachek of the Army Medical Academy worked out instructions for medical examinations of aviators. In 1912, these instructions were made public as a special circular of the Main Army Medical Administration. V. I. Voyachek also lectured at the Army Medical Academy on "The Examination of Aviators."

In that year, a similar medical compilation was prepared for those entering the Aero Club school. This included a long series of tests, a number of special questions, and a page for illness statistics.

In 1913, with the cooperation of physicians, the first flying clothes were designed and introduced.

Thus, aeromedical examinations were introduced in Russia much earlier than in any foreign countries. In Germany, medical examination of flying personnel did not start until 1915, in the US, France, and Italy, not until 1916 and 1917. The work of Kamyn [Camus?] and Neper on the experimental psychological examination of aviators, published in France in 1916, took place much later than the work in this field by the Russian scientist Abramov.

In 1918, when the requirements for selection of aviators were included in the International Convention on Air Transportation, Russia already had been putting them into practice for more than 8 years.

Russian physicians, under the difficult conditions of Tsarist autocracy, which fettered the development of science, laid the exact and methodically correct foundations for the further development of aviation medicine.

The real blossoming of aviation medicine took place only under the Soviet rule. The October Revolution liberated the powers of the nation and opened vast possibilities for the creative power of the Soviet people.

The Soviet government and the Bolshevik Party paid great attention to the development of aviation medicine from the first days of existence of the Soviet state.

Even during the Civil War, in the days of the defense of Tsaritsyn, the position of aviation medical officer in aviation units was created on orders of Stalin. With this order, a special diet for flyers was also established. Thus, the start was made for systematic medical study of flying personnel.

As soon as the country had begun peacetime construction, a commission for dealing with sanitary-medical questions of the aviation service was founded within the Main Administration for Sanitation, by order of the Rev[illegible]tionary Military Council. The commission was made up of representatives of the Main Administration for Military Sanitation, the Main Administration of the Air Force, the Institute of Physiology, the Institute of Physical Culture, the Psychoneurological Institute, the Institute of Labor, and the Labor Protection Center of the All-Union Central Council of Labor Unions.

An active role in the development of aviation medicine was played by the aviation physician S. Ye. Mints. He carefully studied the conditions of flight activity, became an active organizer of the scientific research work in this field, and enthusiastically popularized the idea of aviation medicine. In 1920, together with Granovskiy and the flyer Makeyev, he developed and distributed to all aviation units the first "Statistical Chart of Air Accidents." He later published an exploitation of these charts. Mints brought up the question of founding a special laboratory for the study and improvement of aeromedical conditions of the work of aviators and received the full support of the Revolutionary Military Council. This laboratory was founded in 1924, on the basis of Mints' training laboratory already in operation; subsequently, by special order of the Revolutionary Military Council, the laboratory was named after Dr S. Ye. Mints.

Work on aviation medicine at the Laboratory imeni Mints was conducted by V. V. Andreyev, A. P. Apol'onov, Yu. L. Vasil'ev, N. A. Vishnevskiy, P. I. Yegorov, G. G. Kulikovskiy, A. V. Lebedinskiy, V. G. Mirolyubov, I. K. Sobennikov, V. V. Strel'tsov, and others. This group laid the foundation for the subsequent development of all systems of aviation medicine. This development was directed at maintaining the health and increasing the work capacity of man during flight, and it was also based on clinical study from every angle of the human organism in the process of work activity.

N. M. Dobrotvorskiy, G. G. Kulikovskiy, and the majority of the young coworkers attached to the laboratory were transferred from the Army Medical Academy. They brought with them the better traditions of that famous center of Soviet military medicine. From this time on, simultaneous work on the problem of aviation medicine was carried out by scientific groups at Moscow and Leningrad. The works of Academician L. A. Orbeli, M. P. Brestkin, G. Ye. Vladimirov, A. V. Lebedinskiy, I. R. Petrov, and others created all prerequisites for scientifically founded safety in altitude flights.

Close connection between theory and practice is a characteristic trait of all Soviet aviation medicine. The group of aviation physicians of the Laboratory imeni S. Ye. Mints provided the medical safeguards for the famous flight Moscow-Berlin-Paris-Rome-London-Warsaw-Moscow in 1928, carried out by M. M. Gromov in the Soviet multiengine airplane Wings of the Soviets, and for Shestakov's Moscow-New York flight in 1929, as well as for a number of other flights.

Thanks to the fulfillment of Stalin's first Five-Year Plan, a powerful aviation industry was created, making possible many scientific and technical discoveries in the field of aviation. In connection with this, the Laboratory imeni Mints was reorganized into the aviation sector of the Scientific-Research Experimental Institute of the Red Army, headed by V. V. Strel'tsov. In 1935, this sector, in connection with the further growth of aviation, was reorganized into the Institute of Aviation Medicine imeni Pavlov. At the time of the Great Patriotic War /World War II/, the institute became an affiliate of the Laboratory of Aviation Medicine, attached to the Chair of Physiology of the Army Medical Academy, headed by Academician L. A. Orbeli. A clinical group with a consulting department was developed at the Central Aviation Hospital.

The Central Psychophysical Laboratory and the Institute of Aviation Medicine at once became the centers organizing all scientific work in aviation medicine and drawing into this work a great number of civilian scientific organizations and individual scientists. Thus, I. P. Razenkov's work on the physiology of digestion at high altitudes was carried out in close contact with the group of coworkers of the Institute of Aviation Medicine. This work was awarded the Stalin Prize in 1948.

In 1924, soon after the organization of the Central Laboratory, affiliated with the aviation schools (and later with the districts), the peripheral psychophysiological laboratories were founded. They existed up to 1936 - 1937, and worked in close cooperation with the Laboratory imeni Mints and also with the Institute of Aviation Medicine. Later, their functions were transferred to the district military medical commissions, which carried out expert consulting and scientific work.

The first Soviet physician who mastered flying and attained the rank of pilot-observer was N. M. Dobrotvorskiy. Dobrotvorskiy's work greatly influenced Soviet aviation medicine. His book Letnyy Trud (Aviation Work), issued in 1926, is the first aviation-medicine manual. In this book, Dobrotvorskiy thoroughly and systematically treats various problems. The work has not become obsolete even today.

The first textbook on medical examinations for aviation came out in 1926.

In 1939 and 1941, manuals on aviation medicine were issued. In these the experience of the group of workers of the Institute of Aviation Medicine was summarized.

In the system of aviation medicine, the unity of the physiological, clinical, and examination methods has always been maintained.

In 1929, Zolotarev, Tsekhanovich, and Ratgauz, the physicians of the aviation department, under the direction of G. G. Kulikovskiy, carried out a number of experiments on the question of training the aural vestibule apparatus. Soon after, Prof N. A. Khilov, Leningrad, proposed a four-point suspension-swing system for training. In 1933, G. G. Kulikovskiy published the results of the work in this field and definitely included these types of training among a number of active training methods. In 1935, Vremennaya Instruktsiya po Trenirovke Organov Ravnovesiya (Temporary Instructions on Training the Equilibrium Organs) was published, compiled by a group led by G. G. Kulikovskiy and V. V. Strel'tsov. Finally, in 1939, Kulikovskiy issued a separate monograph which illuminated the entire problem of training the aural vestibule apparatus of flyers. A. P. Popov, in a series of works, developed the questions of aural vestibule training as applied to the task of medical safeguarding of blind and high-speed flying.

Another group investigated the capacity of the organism to withstand high altitudes. P. I. Yegorov originally used an apparatus which involved breathing in a closed system. He also was the first to propose the building of a pressure chamber, in which V. V. Strel'tsov made an ascent on 13 June 1932. Strel'tsov spent the rest of his life in developing the training for high-altitude flight.

A. P. Apollonov and V. G. Mirolyubov compiled the medical portion of the first instructions for high-altitude flights. In this, earlier than in any foreign country, the basic principles of high-altitude training were laid down.

The experience of World War II showed the correctness of the outlook of Soviet aviation physicians, and, in addition, demonstrated the great psychological role of physical culture and sport as the means for emotional outlet and active recreation for flying personnel.

The Bolshevik Party and Stalin himself tirelessly saw to it that our air force should be strong and should expand, that our aircraft should be better than any in the world, and that our flyers should fly further, higher, and faster than any others. With the development of Soviet aviation technique, new problems arose in the field of aviation medicine. These problems found their practical expression in the medical safeguarding of the heroic flights of Chkalov, Gromov, Grizodubovay, and in stratostat ascents.

The excellent safeguarding of long-distance, altitude, and high-speed flights required intense research work by many Soviet aviation specialists. The most important theoretical questions of general physiology in the field of investigation of the effects of altitude, acceleration, and pressure drop, as well as questions of the physiology of the sense organs, were successfully solved by Soviet scientists.

The rapid development of aviation technique introduced the necessity for regular inspection of the state of health of flying personnel.

The requirements regulating the selection of flying personnel were worked out in 192 . The examinations were carried out according to these regulations, adapted to general army standards. Even at that time, data pertaining to aviation characteristics were taken into account. It should be pointed out that, at that time, the widespread form for registering the characteristics of the students was the so-called Il'zin scheme, named for one of the most talented aviation methodicians. The requirements for flying personnel changed more quickly than the general army requirements. The re irements were completely revised in 1924.

The increase in speed and maneuverability of aircraft and the accumulation of aeromedical experience in the study of the effect of acceleration on the organism led to the necessity of a more intense study of the effect of motion /dynamic study/ on flying personnel. This found its expression in the orders issued in 1938.

The aeromedical examination by Soviet physicians has always been considered part of the military medical examination, despite the fact that it is specific. The general principle of Soviet military medical examination, i.e.,.its prophylactic direction, clearly shows in the aeromedical expert consultation and examination.

The physicians of the units, established by order of Stalin at Tsaritsyn, carried out systematic observations of flying personnel and studied the effect of motion on them. The accumulated practical experience and a number of special projects established a thorough system of medical study of flying personnel, as well as a prophylactic system, carried out now by air force physicians under a system which is not matched by any foreign air force.

At the meetings of Soviet parachutists held at Moscow in 1930, at Yevpatoriya in 1931, and at Detskoye Selo in 1932, aviation physicians began studying the effect of parachute jumping on the organism.

The first modern instructions on the selection of parachutists, drawn up under the direction of I. K. Sobennikov, were published in 1931.

During the Great Patriotic War, the Soviet Air Force had a theory of aviation medicine on a methodological basis, a well-thought-out system of medical safeguarding of flights, and a well-trained cadre of aviation physicians. The tremendous experience gained in the war has further increased that knowledge, improved the organization, and strengthened the cadres.

The great and undoubted achievements of Soviet aviation medicine are far ahead of the foreign accomplishments and open an unobstructed road to future progress.

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